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INFOGRAPHIC

GUIDELINES

Guidelines on strategies for the universal implementation of videolaryngoscopy

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OBJECTIVE The Airway Section of the Spanish Society of Anaesthesiology, Resuscitation, and Pain Therapy (SEDAR), the Spanish Society of Emergency Medicine (SEMES), the Latin American Federation of Emergency Medicine (FLAME) and an international group of airway experts (IAG) aimed to establish multidisciplinary recommendations advocating for the universal use of videolaryngoscopy (VL) in both emergency and planned care settings.

DESIGN A committee of experts from the two national scientific societies and an international group of airway experts was convened. Relevant research questions aligning with the document's objective were identified. A rapid systematic review of the evidence was performed, and the quality of evidence was assessed. Recommendations were formulated using the GRADE methodology (Grading of Recommendations Assessment, Development, and Evaluation) The entire process was conducted independently of industry funding.

METHODS Six domains were defined pertaining to VL: Clinical Benefits; Infrastructure and Accessibility; Clinical Guidelines and Protocols; Teaching and Clinical Training; Dissemination and Promotion of Clinical Benefits; Innovation, Sustainability, and Research. For each domain, specific questions were developed using the PICO model (Population, Intervention, Comparison, and Outcomes). A literature search was conducted following PRISMA-R guidelines and analysed using the GRADE methodology.

RESULTS The synthesis process resulted in 12 recommendations. Due to the low quality of available evidence, most recommendations were formulated based on expert opinion.

CONCLUSION The experts achieved strong consensus, formulating 12 recommendations to support strategies aimed at universalising the use of videolaryngoscopy.

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SHOUT
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IT

Introduction

Videolaryngoscopy (VL) has transformed airway management by significantly improving first-attempt success rates in tracheal intubation (TI) compared to direct laryngoscopy (DL).[1] This advance is critical, as reducing the number of attempts lowers the risk of trauma, hypoxaemia and adverse cardiovascular events.[2] Despite its benefits, the universal adoption of VL faces economic, logistical and educational barriers.[3]

During the COVID-19 pandemic, the use of VL surged, underscoring its advantages in protecting both the operator and the patient in critical settings.[4,5] However, resistance to change and variability in implementation highlight the need for organisational and educational strategies to promote its adoption in clinical practice, in alignment with evidence-based guidelines. Bridging the gap between scientific advancements and clinical practice is essential for improving patient safety. Engaging international, national and institutional leaders in airway management could play a pivotal role in driving effective interventions.[3]

In response, the Spanish Society of Anesthesiology, Resuscitation, and Pain Therapy (SEDAR), the Spanish Society of Emergency Medicine (SEMES), the Latin American Federation of Emergency Medicine (FLAME) and an international group of airway experts (IAG) have collaborated on this consensus document. The primary aim is to establish recommendations to facilitate the universal adoption of VL. The document outlines strategies to overcome existing barriers and describes best practices for implementing this technology across diverse clinical settings. Table 1 highlights the main barriers and potential facilitators for achieving universal adoption of VL.

The widespread integration of VL not only enhances safety and effectiveness in airway management but also optimises responses in emergency situations, improving clinical outcomes and reducing complications associated with TI.[6] This consensus guideline provides practical guidelines to address implementation challenges and identifies specific facilitators that can accelerate VL's adoption. By doing so, SEDAR, SEMES and FLAMES reaffirm their commitment to excellence in healthcare and the advancement of patient safety.

Objectives

To provide evidence-based recommendations from SEDAR, SEMES, FLAME and IAG to facilitate the universal use of VL.

Methodology

Formation of the expert committee

SEDAR and SEMES were the driving forces behind the project, sharing their strategic direction with international partners. An interdisciplinary committee of experts was convened by both societies, the FLAME and the IAG to lead the initiative. The expert panel guide was established using a rigorous, methodologically sound process to ensure global representation and multidisciplinary expertise.

(1) Scope definition: experts were chosen from anaesthesiology, critical care, emergency medicine, and prehospital care to address the guide's multidisciplinary requirements.
(2) Inclusion criteria: selection emphasised academic and clinical expertise, global and specialty diversity, peer recognition, and leadership in airway management.
(3) Nomination and recruitment: Candidates were identified through an open call for nominations and strategic invitations to fill representation gaps.

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Table 1 The main barriers and proposed facilitators for the universal adoption of videolaryngoscopy

Barriers	
Costs	Direct costs: the acquisition of videolaryngoscopes can be expensive, especially for hospitals with limited budgets. Maintenance and updates: the cost of maintaining and updating the equipment can be significant.
Staff training	Training: medical staff need specific training to properly use videolaryngoscopes, which requires time and resources. Learning curve: professionals accustomed to traditional laryngoscopy techniques must complete a learning curve to use VL. Diversity of devices: healthcare professionals have individual preferences regarding which videolaryngoscope they prefer to use.
Resistance to change	Preference for traditional techniques: some professionals may resist changing traditional laryngoscopy methods for VL due to comfort and familiarity with existing techniques. Organisational culture: the implementation of new technologies may face resistance within the hospital or clinic's organisational culture.
Availability and access	Access in rural areas: the availability of videolaryngoscopes may be limited in rural or resource-poor areas, affecting its universal adoption.
Sustainability and logistics	Sustainability concerns: the environmental impact of single-use components in videolaryngoscopy raises concerns in some institutions. Storage requirements: the need for appropriate storage space for single-use parts of VL devices can be a logistical challenge, particularly in resource-limited settings.
Facilitators	
Improved patient safety	Better visualisation and accuracy: VL provides better visualisation of the glottic structures, which can reduce the risk of complications related to tracheal intubation. Reduction in failed TI: improves success rates for intubation, especially in patients with difficult airways.
Technological advancements	Continuous innovations: the development of more advanced and economically accessible videolaryngoscopes can facilitate adoption. Compatibility with mobile devices: some videolaryngoscopes can be integrated with mobile devices, making them more accessible and easier to use.
Institutional support and financing	Grants and assistance: availability of grants and financing for purchasing of advanced medical equipment. Public health policies: government initiatives and public health policies that promote the adoption of advanced technologies at all levels of healthcare.
Training and education	Training programs: the implementation of training and simulation programs for medical personnel can accelerate the adoption of VL Continuous education: ongoing medical education about the benefits and use of VL can reduce resistance to change and improve competency in its use.

VL, videolaryngoscopy; TI, tracheal intubation.

(4) Selection process: a multidisciplinary steering committee evaluated candidates based on qualifications, contributions, and alignment with the guide's goals.
(5) Validation: credentials were verified through publications, leadership roles, and global impact.
(6) Panel composition: fifty experts from diverse regions and specialties were selected, ensuring representation from middle-, and high-income countries and various practice settings.

Identification of key domains

The essential content and primary domains of the document were defined, focusing on the most relevant research questions for clinical practice and change management. These questions were formulated using the PICO framework (Patient, Intervention, Comparison, Outcome).

Bibliographic search, analysis, and synthesis of evidence

A rapid systematic review was conducted following PRISMA-RR (PRISMA for Rapid Reviews) guidelines.[7] Relevant studies were identified by a scientific documentalist (UGC) using multiple databases, including MEDLINE, Embase, Web of Science, Cochrane CENTRAL, focusing on publications from January 2010 to December 2024. The study selection process is illustrated in Fig. 1, following the PRISMA flow diagram.

A search strategy was developed with the support of a health sciences librarian, incorporating specific search terms combined with Boolean operators. The main terms used were: 'videolaryngoscopy', 'indirect laryngoscopy', 'airway management', 'tracheal intubation', 'airway emergencies' and 'tracheal intubation complications'. Combinations such as: ('videolaryngoscopy' OR 'indirect laryngoscopy') AND ('airway management' OR 'tracheal intubation') AND ('emergency' OR 'complications') were also applied. It is important to note that 'videolaryngoscope' is not currently listed as a MeSH term, which may affect the comprehensiveness of database retrieval. Alternative terminology and keywords were therefore used to optimise the search strategy.

Filters were applied to refine the results to articles published within the last decade, prioritising studies in English and Spanish. Particular attention was given to systematic reviews, meta-analyses, clinical trials, observational studies, and clinical practice guidelines.

Primary endpoints

(1) Clinical efficacy and safety:
   (a) Success rate of first-attempt TI with VL *versus* DL.
   (b) Incidence of complications (oesophageal intubation, hypoxaemia, trauma and cardiovascular events) during TI.
   (c) Incidence of TI failures in emergency and critical care settings.

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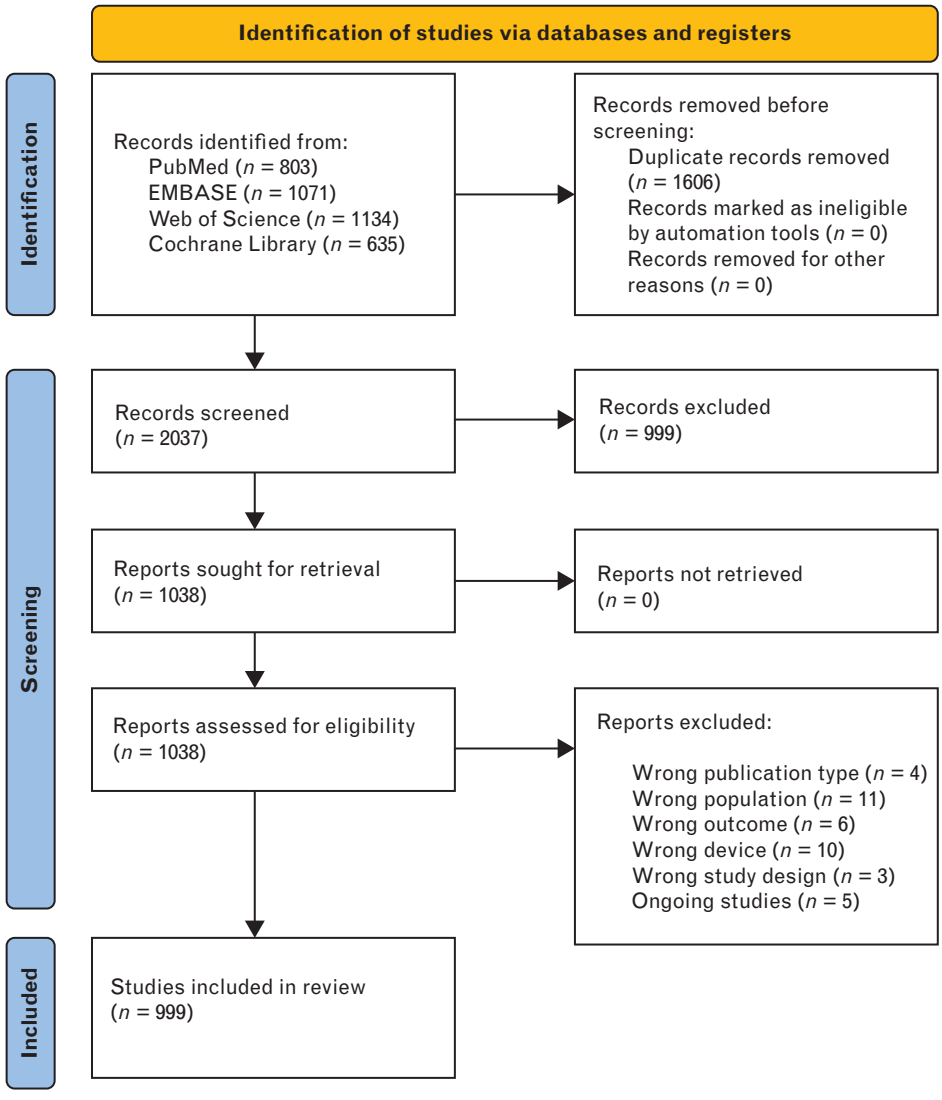
Fig. 1 PRISMA flow diagram for study selection.


Identification of studies via databases and registers
Identification
Records identified from:
PubMed (n = 803)
EMBASE (n = 1071)
Web of Science (n = 1134)
Cochrane Library (n = 635)
Records removed before screening:
Duplicate records removed (n = 1606)
Records marked as ineligible by automation tools (n = 0)
Records removed for other reasons (n = 0)
Screening
Records screened (n = 2037)
Records excluded (n = 999)
Reports sought for retrieval (n = 1038)
Reports not retrieved (n = 0)
Reports assessed for eligibility (n = 1038)
Reports excluded:
Wrong publication type (n = 4)
Wrong population (n = 11)
Wrong outcome (n = 6)
Wrong device (n = 10)
Wrong study design (n = 3)
Ongoing studies (n = 5)
Included
Studies included in review (n = 999)

(d) Reduction in TI time.

(2) Adoption in clinical practice:

(e) Percentage of VL adoption in anaesthesia and emergency settings.

(f) Impact of training on the rate of VL use by healthcare professionals.

Secondary endpoints

(1) Human factors and competence:

(a) Assessment of competence acquired after VL training programs.

(b) Measurement of confidence and perceived safety among healthcare professionals after training in VL.

(2) Cost minimisation:

(a) Comparative cost analysis between VL and DL, including maintenance and training.

(b) Economic impact of reduced hospital stays and intensive care (ICU) usage due to fewer complications.

(3) Staff satisfaction and organisational culture:

(c) Measurement of satisfaction and willingness to embrace change among healthcare professionals when implementing this technology.

(d) Analysis of the impact of VL on medical team cohesion and coordination.

Two reviewers (MAGR and ASM) conducted a preliminary selection of deduplicated titles and abstracts using Rayyan software.[8] This was followed by a full-text review by three independent reviewers (AAG, DGR and MCR), who documented the reasons for exclusion. The references in the identified articles, as well as relevant subsequent publications, were also considered. A limited

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Table 2 Summary of recommendations and consensus statement

N°	Recommendation	Grade of recommendation Level of evidence
1.	Routine use of VL over DL as the primary device for TI is recommended.	*Strong recommendation; moderate level of evidence.* (⊕⊕⊕⊖)
N°	**Consensus Statement**	**Level of agreement (%)**
2.	The use of VL as the primary device is more cost-minimising compared to DL.	85
3.	The use of VL as the primary device is associated with higher quality of care compared to DL.	95
4.	The use of VL as the primary device favours human factors compared to DL.	90
5.	For universal use of VL, universal availability in all care areas is required, including the operating room, emergency department, intensive care unit, and other locations where airway management is performed.	100
6.	The development and dissemination of clinical practice guidelines with evidence-based recommendations integrating VL as the standard of care can facilitate its universal adoption.	100
7.	The development and dissemination of specific algorithms and cognitive aids for the use of VL facilitate universal adoption.	95
8.	The development and dissemination of a specific scale for TI with VL will facilitate its universal adoption.	90
9.	Integrating high-fidelity simulation as a central component in videolaryngoscopy training to facilitate its universal adoption.	95
10.	Dissemination and awareness programs on the benefits of videolaryngoscopy compared to DL are necessary to overcome resistance to change.	95
11.	Innovation and sustainability programs are essential to achieve universal adoption of videolaryngoscopy and to ensure it remains sustainable over time.	95
12.	Research is necessary to evaluate the universalization process.	95

An overview of the expert consensus regarding the universalisation of videolaryngoscopy is provided. It includes the strength of each recommendation, the level of supporting evidence based on the GRADE system, and the level of agreement among experts. DL, direct laryngoscopy; VL, videolaryngoscopy; TI, tracheal intubation.

number of references were included to provide a concise justification for each recommendation, prioritising high-quality studies.

For each bibliographic reference cited, a level of evidence was assigned based on the study type, with potential reassessment based on the methodological quality. An overall level of evidence was determined for each outcome by evaluating the individual references, the consistency of results across studies, the directness of the evidence and an analysis of the cost-benefit scope.

Formulation of recommendations

The recommendations were formulated and classified according to the GRADE system (Grading of Recommendations Assessment, Development, and Evaluation).[9] The initial draft of the recommendations and their justifications were prepared and critically reviewed by four authors. The draft was then shared with the full committee for further review prior to initiating the consensus process.

Virtual consensus conferences were held in October and November 2024, during which authors reviewed and finalised the recommendations. Sections with low-quality evidence or lack of supporting literature were addressed using a Delphi questionnaire. The questionnaire was completed by 20 Working Group members from SEDAR and SEMES. For topics where sufficient consensus was achieved (>80%), an expert statement was formulated. Each recommendation's formulation and classification was confirmed during this process.

After receiving final approval from the group of authors, the manuscript was submitted for review and approval by the supporting societies.

Questions and recommendations

A detailed summary of all recommendations, their level of evidence, and expert consensus agreement is available in Table 2.

Domain 1. Clinical benefits

Question: In patients requiring tracheal intubation, is the use of videolaryngoscopy as the primary device superior in terms of efficacy and safety compared to direct laryngoscopy?

Justification

Failure on the first attempt at TI significantly reduces the likelihood of success in subsequent attempts.[10–12] Multiple attempts are associated with increased risks of upper airway trauma, oesophageal intubation, hypoxaemia and cardiovascular events, 'Cannot Intubate, Cannot Oxygenate' (CICO) scenarios, unexpected admissions to critical care units or even death.[13–18] Moreover, up to 93% of difficult TIs are estimated to be unanticipated.[19] Therefore, the initial technique should offer the highest probability of first-attempt success.[10,20–23]

VL has been extensively compared to DL in terms of efficacy and safety for TI. Although there is significant heterogeneity across studies, most meta-analyses demonstrate the superiority of VL over DL.[24,25] Generally, VL improves first-attempt success rates,[1,26–38] enhances glottic visualisation[1,29,30,32,34–37,39–46] and reduces complications, particularly upper airway trauma and oesophageal intubation,[30,31,33–36,38,40,43–45,47–50] with reductions as high as 50%.[1]

In addition to increasing the likelihood of successful TI, VL reduces failed attempts, and shortens the overall TI time, particularly in critically ill patients or during emergency situations.[51,52] This is especially relevant in

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time-sensitive scenarios where achieving first-attempt success is paramount.[18] Given the robustness of existing data, it is unlikely that future trials or meta-analyses will yield conclusions significantly altering the current understanding of VL's efficacy and safety compared to DL for TI in adult patients.[51,53]

In summary, the current body of evidence strongly supports the widespread adoption of VL as the first-choice device for TI due to its superior efficacy and safety over DL.

It is important to acknowledge, however, that, while VL offers significant clinical advantages over DL, no device is universally effective in all scenarios. The use of VL does not eliminate the need for a thorough airway assessment and consideration of an awake technique whenever appropriate (e.g. ATI:FB or VL). Therefore, robust and well defined rescue plans must be in place to manage potential TI failures when using VL. Additionally, it is important to recognise the importance of using VL with an appropriate blade type; standard geometry/Macintosh/Miller (SG-) or hyperangulated (HA-). For example, using SG-VL for routine situations when no difficulty is anticipated, and HA-VL when patient anatomy suggests that difficulty may be encountered with SG blade types.

Recommendation

R1. Routine use of VL over DL as the primary device for TI is recommended due to its superior efficacy and safety.
Strong recommendation; moderate level of evidence.
(⊕⊕⊕⊖)

* The evidence supporting this recommendation is based on systematic reviews and meta-analyses that indicate higher first-attempt success rates and lower complication risks with VL. (See **Supplementary Material 1,** http://links.lww.com/EJA/B147 for the full GRADE evidence table.)

Question: In patients requiring intubation, is the use of videolaryngoscopy as a primary device more cost-minimising compared to direct laryngoscopy?

Justification

The cost-effectiveness assessment of VL compared to DL for TI should account for factors such as equipment acquisition and maintenance costs, staff training expenses, procedure time, the use of adjuncts and rescue devices and hospital costs associated with potential complications. To date, no formal evaluation has been published.

VL devices generally have higher acquisition and maintenance costs compared to DL devices; however, these costs have progressively declined over time.[54] Some studies indicate that the additional expenses associated with VL are offset by a reduced incidence of complications and the need for additional interventions.[55,56] VL decreases the likelihood of failed attempts and complications, and shortens hospital stay.[55] Additionally, VL facilitates airway management learning and enhances efficiency in emergencies, and reduces training costs. This is particularly advantageous in difficult-to-access environments or prehospital care settings.[57–59]

Although VLs require a higher initial financial investment, their durability and ability to reduce critical incidents may make them more cost-effective in the long-term, depending on the quality and model of the device. An analysis of the potential economic impact of universal use of videolaryngoscopy as a primary device, compared to direct laryngoscopy, is presented in the Appendix, http://links.lww.com/EJA/B146 based on available literature.

Recommendation

R2. Experts suggest that the use of VL as the primary device may be more cost-minimising compared to DL.
Expert opinion (strong agreement, 85% consensus among experts)

Question: In patients requiring tracheal intubation, is the use of videolaryngoscopy as the primary device associated with a higher quality of care compared to direct laryngoscopy?

Justification

The quality of care in airway management is assessed through indicators such as first-attempt success rates, a reduction in complications, and the safety and satisfaction of both patients and medical staff.[60] Evidence indicates that VL enhances several aspects of quality care compared to DL. VL demonstrates a higher first-attempt success rate, which reduces the risk of complications, such as hypoxia and trauma, while also alleviating physiological stress for the patient and psychological stress for the operator.[61] However, it is important to note that despite providing an improved glottic view, VL can present challenges with intubation in some cases. Addressing these challenges through appropriate training and the selection of compatible adjuncts is essential to maximising the benefits of VL in airway management.

Furthermore, VL facilitates learning about laryngeal visualisation and TI and boosts confidence, particularly in challenging situations,[62–67] such as emergencies and cases involving complex airways. This improvement in

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team performance enhances the overall clinical experience.[68] Consequently, VL appears to be the preferred method for improving both the safety and experience of patients and medical staff during TI procedures.[13]

Recommendation

R3. Experts suggest that the use of VL as the primary device is associated with higher quality of care compared to DL.
Expert opinion (strong agreement, 95% consensus among experts)

Question: In patients requiring tracheal intubation, does videolaryngoscopy favour human factors optimisation compared to direct laryngoscopy?

Justification

Human factors during TI include operator stress, ease of use, learning, and team collaboration.[69] VL has demonstrated significant benefits in these areas compared to DL.[20,70–74]

VL reduces operator stress by providing better laryngeal visualisation, which is particularly advantageous in complex TIs and for less experienced operators. It also facilitates learning and skill development by frequently offering a clear image of the larynx without requiring direct alignment of anatomical axes.[68,75] This capability may shorten the learning curve for TI and increases operator confidence.[76]

Moreover, VL enables a 'shared airway' approach, where the real-time display of the procedure on the screen allows for concurrent supervision and timely intervention by other team members.[77] This fosters a shared mental model among the team, as the visualisation allows everyone involved to assess and confirm or challenge tube placement if necessary. Improved visualisation also minimises errors, increasing the accuracy and efficiency of TI, particularly in high-pressure scenarios.[78] Additionally, the use of VL promotes a flattened hierarchy in critical situations, as all team members can actively contribute to the decision-making process based on the shared view of the intubation.

Barriers to universalisation and standardisation

The diversity of VL devices presents a barrier to universal adoption. The European ISO certification for human factor-related features required for videolaryngoscopes addresses this variability and helps mitigate confusion and inconsistencies in clinical practice.[79]

This certification ensures that devices meet standardised criteria for usability, ergonomics and safety – key elements for optimal performance and ease of use. By establishing a consistent benchmark, ISO certification supports broader adoption, enhances user confidence, and aids healthcare institutions in selecting devices aligned with best practices and human-centred design principles. Ultimately, this contributes to improved patient safety and operational efficiency.

Recommendation

R4. Experts suggest that the use of VL as the primary device favours human factors compared to DL.
Expert opinion (strong agreement, 90% consensus among experts)

Domain 2. Infrastructure and accessibility

Question: In patients requiring tracheal intubation, does the immediate availability of videolaryngoscopy in all care areas facilitate its universal adoption as the primary device?

Justification

One of the primary barriers to the universal adoption of VL is the lack of availability of a videolaryngoscope across all care units.[3] The onset of the COVID-19 pandemic led to a significant increase in the purchase, availability and use of VL worldwide, following international recommendations that advocated for its use as the first option.[4,24,74,80–82] However, the presence of VL has not yet reached the widespread prevalence of DL.[83]

In surgical settings, ensuring the availability of one device per operating room could facilitate VL adoption. Additionally, to maximise utility, it is essential to ensure the availability of both standard geometry (SG) and hyperangulated (HA) blade types. Nonetheless, a critical challenge to its widespread integration into all TI stations remains the economic burden, particularly in resource-limited settings. The acquisition cost of VL devices is a significant limiting factor. While technological advancements are expected to drive down costs over time, it is crucial to develop strategies for acquisition, funding, and implementation.[3]

Standardisation and selection of videolaryngoscopy devices

The wide variety of blade models and designs available on the market adds complexity to VL adoption. To address this, standardising the use of at least one primary model within an institution is recommended.[84]

This approach promotes institutional learning, reduces confusion and facilitates consistent maintenance and cleaning protocols.[85]

Device selection should be informed by the specific clinical context and available evidence.[86] Key considerations include:

(1) Screen type: a model with an integrated screen offers greater portability, which can be advantageous in emergency or prehospital settings. However, devices

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with an external monitor provide a larger display, improving visibility for the entire team, which can be beneficial in teaching scenarios or complex procedures.
(2) Blade type: single-use blades (to prioritise infection control) *versus* reusable blades (to minimise environmental impact and address infection processing challenges).
(3) Cost: total acquisition and maintenance costs, as VL costs can vary up to 12-fold.[87] Costs should also account for service contracts, decontamination processes, charging points, batteries, screens, cables and environmental impact, as these factors significantly influence the overall expense and sustainability of the device.
(4) Single use *vs.* reusable: single use to prioritise infection control and address challenges in reprocessing; reusable to minimise environmental impact.

Centralised, large-scale procurement and agreements with industry partners to control costs are recommended. A phased implementation approach, accompanied by impact evaluations, may also be beneficial.

Despite the initial investment, the ability of VL to reduce complications, TI failures and hospital stay durations makes it a cost-effective solution in the long-term.

Recommendation

R5. Experts suggest that for universal use of VL, universal availability in all care areas is required, including the operating room, emergency department, intensive care unit and other locations where airway management is performed.
Expert opinion (strong agreement, 100% consensus among experts)

Domain 3. Guidelines and clinical protocols

Question: Can the development and dissemination of a clinical practice guideline that integrates videolaryngoscopy as the standard of care facilitate its universal adoption?

Justification

A national clinical guideline tailored to the specific healthcare setting provides a structured framework that enables professionals to follow standardised evidence-based steps, thereby reducing variability in outcomes. The inclusion of evidence-based recommendations encourages the adoption of best practices by drawing on studies that identify the safest and most effective techniques and approaches.[88] This not only enhances operator confidence but also minimises the risk of critical errors – particularly vital in emergency situations where precision and speed are paramount.

It is important to note that guidelines not only establish standards but also direct practice in airway management by identifying areas where training should be focused. This distinction between guiding practice and providing training is subtle yet crucial. Additionally, such guidelines facilitate training by offering a clear, structured reference that professionals can rely on when learning the technique. This approach ensures effective knowledge transfer across different levels of care and promotes greater consistency in the use of VL, irrespective of location or institutional resources. As a result, it supports the broader, safer adoption of VL.

From DAS 2015, which advocated for everyone to be trained in and have access to VL, to CAFG,[89,90] PUMA[78] and SEDAR in the 2020s,[91,92] which recommend universal VL whenever possible, guidelines have evolved significantly to promote a structured approach to airway management. The guidelines published in 2024 by SEDAR, SEMES and SEORL[91,92] provide a strong national framework for managing change.[93] However, a multimodal approach will be necessary to overcome existing barriers and ensure successful implementation.

Recommendation

R6. Experts suggest that the development and dissemination of clinical practice guidelines with evidence-based recommendations integrating VL as the standard of care can facilitate its universal adoption.
Expert opinion (strong agreement, 100% consensus among experts)

Question: Can the development and dissemination of algorithms and cognitive aids for the use of videolaryngoscopy facilitate its universal adoption?

Justification

A cognitive aid is an essential tool for guiding healthcare professionals in the systematic use of VL, particularly in managing difficult airways.[94] This aid is designed to align with the degree of difficulty, offering clear steps and resources at each level to optimise success rates while minimising the number of attempts, errors and omissions.[94] Cognitive aids for VL play a key role in its broader adoption by standardising procedures, reducing cognitive load and simplifying decision-making.[95] Acting as visual reminders of critical steps, they enhance technique retention and enable faster, more efficient execution.[95,96] This not only improves safety – especially in emergency situations where first attempt success is crucial – but also increases operator confidence.[97]

Additionally, cognitive aids serve as effective training tools,[98] enabling a wider range of healthcare professionals to adopt VL in various, less specialised clinical settings. Figure 2 illustrates the cognitive aid proposed by SEDAR, SEMES, FLAME and IAG for the effective use of VL.

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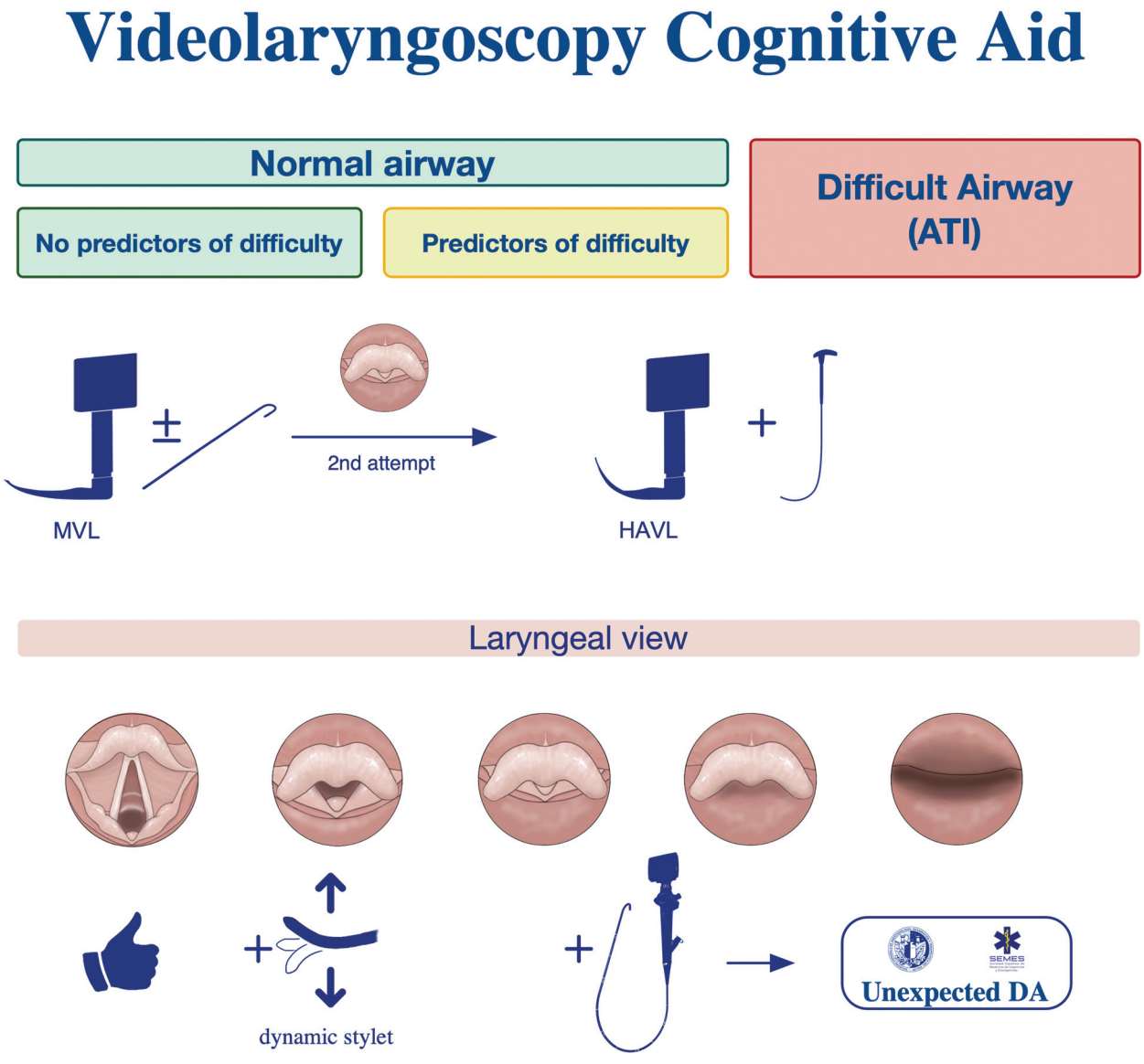
Fig. 2 Cognitive aid for the use of videolaryngoscopy.



This aid indicates the selection of the videolaryngoscope or blade type based on airway characteristics (upper section) and the type of adjunct in case of difficulties, according to the laryngeal view obtained with indirect laryngoscopy (lower section). In case of a routine airway without predictors of difficulty, the appropriate primary videolaryngoscope should be the one with a Macintosh-type blade (optional use of stylet), while in a normal airway with difficulty predictors or a known difficult airway (in this case, awake intubation), a device with a hyperangulated blade and preconfigured stylet should be used. A hyperangulated blade would be the blade of choice if performing an awake tracheal intubation with a VL. The recommended rescue adjuncts based on glottic view according to the VIA scale are: grade 1 (POGO 100%) laryngeal view: not required; grade 2 (POGO >50%): dynamic stylet; grade 3 and 4 (POGO <50%): combined use with a fibreoptic bronchoscope; in the case of a null laryngeal view: follow the SEDAR SEMES algorithm for unanticipated difficult airway.

Recommendation

R7. Experts suggest that the development and dissemination of specific algorithms and cognitive aids for the use of VL facilitate universal adoption.
Expert opinion (strong agreement, 95% consensus among experts)

Question: Can the development and widespread dissemination of a standardised scale for tracheal intubation using a videolaryngoscope facilitate the universal adoption of videolaryngoscopy?

Justification

A dedicated scale for VL offers a standardised framework to consistently assess procedural difficulty, tailor treatment to specific scenarios, and enhance decision-making. This approach reduces variability in outcomes, helps

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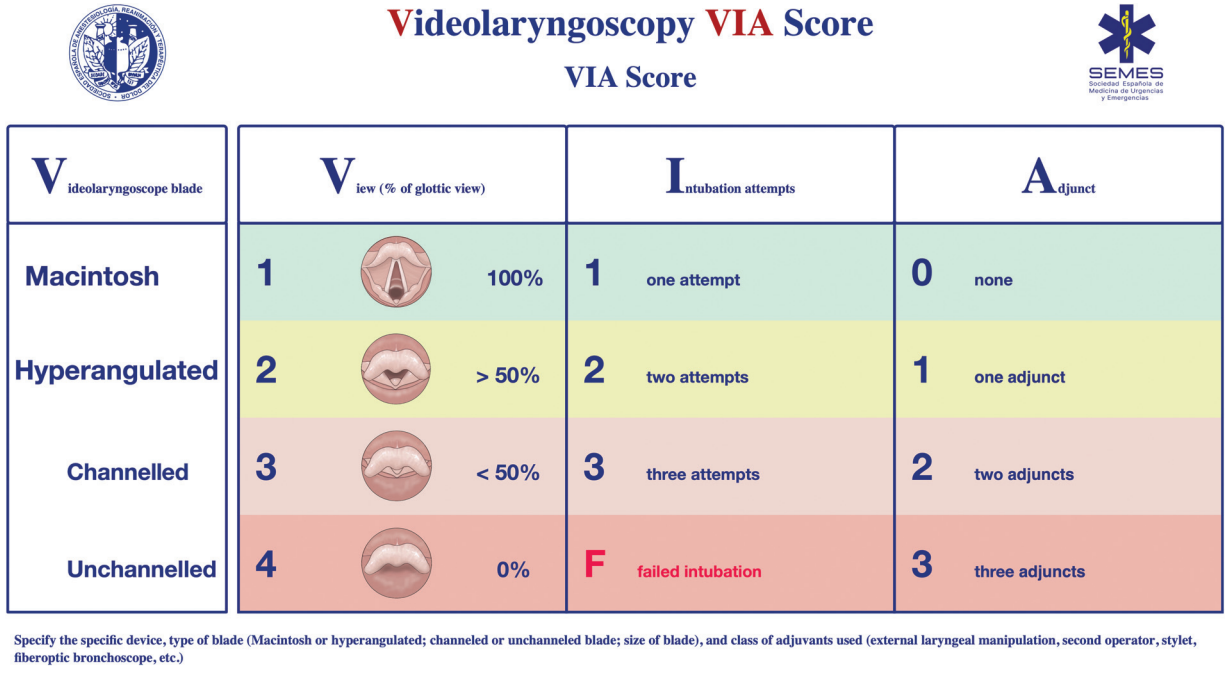
Fig. 3 'VIA' scale for tracheal intubation with videolaryngoscopy.



The proposed scale qualitatively categorises tracheal intubation via videolaryngoscopy according to the type of device blade, and quantitatively based on the glottic view obtained, the number of tracheal intubation attempts, and the number of adjuncts used. Thus, tracheal intubation could be characterized by a letter (M, Hc, Hu) and a three-digit code. The higher the code value, the greater the difficulty.

identify more complex cases, and supports more precise and safer interventions.[99]

Furthermore, establishing a shared terminology among healthcare professionals is essential for structured and effective training.[100] In emergency situations, the use of such a scale enables rapid assessment, decreases cognitive load and facilitates decision-making under pressure.

The evaluation of TI using VL has highlighted the need for standardised tools to ensure safer and more efficient airway management. Traditional scales, such as the Cormack–Lehane classification[101] and the POGO scale,[102] primarily focus on glottic visualisation but fail to account for the trajectory of the endotracheal tube or specific challenges associated with VL, such as the 'can see, but can't intubate' scenario.[99]

Existing tools offer partial solutions but have notable limitations.[99] The VIDIAC score[103] is widely validated but does not address critical aspects such as the number of TI attempts or the use of adjunct devices. The PeDiAC score,[104] tailored for paediatric populations, incorporates tube trajectory but has limited applicability in adult patients. Other scales, such as the Intubation Difficulty Scale (IDS),[105] Fremantle[106] and Video Classification of Intubation (VCI),[107] evaluate factors like ease of endotracheal tube insertion, yet they face challenges in terms of validation, objectivity and consistent application to VL scenarios.

An ideal tool for VL assessment should integrate simplicity, versatility, interobserver reliability, clinical relevance and strong evidence-based support. A standardised evaluation framework would enable accurate classification of TI difficulty, improve communication among interdisciplinary teams and facilitate research and training.[100] Furthermore, it would support the development of tailored clinical protocols, optimise resource allocation and enhance patient safety.[99] The proposed tool would unify current methodologies, incorporate technological advancements, and standardise documentation to ensure consistent and effective airway management across diverse clinical settings. Figure 3 shows the 'VIA' scale proposed by SEDAR, SEMES, FLAME and IAG for grading tracheal intubation with videolaryngoscopy.

Recommendation

R8. Experts suggest that the development and dissemination of a specific scale for TI with VL will facilitate its universal adoption.
Expert opinion (strong agreement, 90% consensus among experts)

Domain 4. Teaching and clinical training

Question: Is simulation-based training on the use of videolaryngoscopes an effective way to universalise videolaryngoscopy?

Justification

Continuous education and training are vital for integrating new technologies into clinical practice. Establishing

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official national training programs that combine hands-on experience with an evidence-based approach is essential for airway management. Regularly organising courses, workshops, and seminars on the use of VL serves as a key facilitator. Effective VL training requires skilled instructors and a structured curriculum. While certain technical skills can be partially acquired using task trainers or mannequins, proficiency necessitates expert-guided instruction with deliberate practice.[108] The learning curve for VL varies among individuals but generally requires repeated exposure and supervised practice to achieve competence. Initially, operators may experience challenges in blade positioning, tube guidance and video interpretation. However, structured training and cumulative experience significantly enhance efficiency, reducing procedural time and improving overall success rates. Incorporating supervised clinical practice early in training can accelerate skill acquisition and confidence. The learning curve for VL is shorter than that of direct laryngoscopy.[109] Clinicians with prior experience in TI using direct laryngoscopy[110] but unfamiliar with hyperangulated-blade VL can attain proficiency after approximately 12 supervised attempts, demonstrating a rapid adaptation to the technique.[111]

Simulation is a valuable tool for team-based training,[112] enhancing crew resource management and interdisciplinary collaboration. High-fidelity simulators provide a safe environment for professionals to develop skills and build confidence before applying them in real clinical settings.[113] Team-based learning enhances interdisciplinary coordination, which is crucial for success in emergencies.[114] Clinical guideline algorithms and cognitive aids offer a structured, evidence-based framework for teaching, reducing reliance on memory in high-pressure situations and serving as quick reference tools.

Continuous learning and practice are crucial to maintaining and refining skills over time. Proficiency in VL diminishes without consistent practice,[73] highlighting the importance of incorporating periodic refresher sessions and competency assessments into training programs. Additionally, integrating VL into academic curricula fosters long-term competence and familiarity, promoting its adoption across various clinical settings.

A competency certification system could further facilitate this process.

Recommendation

R9. Experts suggest integrating high-fidelity simulation as a central component in videolaryngoscopy training to facilitate its universal adoption.
Expert opinion (strong agreement, 95% consensus among experts)

Domain 5. Dissemination and promotion of benefits

Question: Are dissemination and awareness programs on the benefits of videolaryngoscopy compared to direct laryngoscopy useful for overcoming resistance to change?

Justification

The adoption of VL in clinical practice faces significant barriers, primarily stemming from familiarity with conventional methods and the perception that DL remains sufficient for airway management. Many clinicians may not perceive a pressing need to transition to VL, as they rarely encounter difficulties with DL. Data from the NAP4[115,116] report and Norskov's study[19] suggest that despite the documented incidence of difficult airways, only a minority of cases actually present significant challenges. Given that only approximately two out of every hundred intubations may be considered difficult,[19] practitioners may develop a sense of confidence in their established DL techniques, leading to resistance toward adopting new technologies. Likewise, some professionals may hesitate to transition from traditional DL techniques to VL, fearing the loss of competence in the dependable use of DL.[117]

This resistance is further reinforced by evidence from Prekker *et al.*,[26] which indicates that highly experienced DL users may not derive the same benefits from VL as less experienced practitioners. These findings highlight the necessity of structured training programs tailored to different levels of expertise. The integration of VL education for novice practitioners, as well as for intensive care unit (ICU) and emergency department (ED) trainees,[118] is crucial to standardising airway management practices and enhancing patient safety. Effective training is key to adopting VL as it builds proficiency, and boosts clinical confidence, ultimately leading to increased recognition of its benefits.

Educational initiatives play a pivotal role in mitigating resistance to VL adoption. Targeted awareness campaigns through media platforms and professional networks, alongside structured courses, seminars and workshops, can effectively demonstrate the benefits of VL. These interventions not only familiarise practitioners with VL equipment but also provide hands-on experience to build competence and confidence in its use.

Industry collaboration is another key factor in promoting VL adoption. By facilitating access to VL technology, offering technical training, and contributing to educational programs, industry stakeholders can support live demonstrations and practical workshops. Furthermore, their involvement in awareness campaigns, development of educational materials and sponsorship of research can help validate the clinical benefits of VL, ultimately fostering its acceptance as a standard of care.

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While passive exposure to VL technology may not suffice to encourage widespread adoption, structured knowledge dissemination through training and industry-backed initiatives can significantly influence practitioners' willingness to embrace VL. By addressing perceived barriers and emphasising the tangible benefits of VL, the healthcare community can work toward a more standardised and effective approach to airway management.

Recommendation

R10. Experts suggest that dissemination and awareness programs on the benefits of videolaryngoscopy compared to DL are necessary to overcome resistance to change.
Expert opinion (strong agreement, 95% consensus among experts)

Domain 6. Innovation, sustainability, and research

Question: Are innovation and sustainability programs useful to facilitate the universal adoption of videolaryngoscopy?

Justification

Innovation is the driving force behind the continuous evolution of VL, leading to the development of devices that are more accessible, efficient and user-friendly.[119] These advancements enable adaptation to a wide range of clinical settings, including resource-limited environments.[120] In particular, affordable VLs are being developed to expand access in developing countries,[121–123] although their performance may still be inferior to conventional videolaryngoscopes.[124] Despite these limitations, ongoing improvements in technology and design hold promise for narrowing this gap, ensuring that more patients worldwide can benefit from safer and more effective airway management.

Equally important is the commitment to sustainability, which ensures the long-term viability of VL expansion by addressing both economic efficiency and environmental impact.[125] The design of durable, resource-efficient devices – crafted from recyclable or biodegradable materials – helps minimise waste and reduce the ecological footprint of medical equipment.[126] A key challenge in VL adoption is the reliance on single-use blades, which, while enhancing infection control, contribute to increased medical waste. The healthcare industry plays a critical role in this transformation by not only developing more sustainable materials but also implementing systems for the collection, recycling, and, wherever feasible, the reprocessing of single-use components.[126] By integrating sustainable practices into manufacturing and distribution, medical technology companies align with the global healthcare sector's increasing commitment to environmental responsibility.[126] Addressing the sustainability concerns associated with VL – particularly the management of single-use components – represents a crucial opportunity for innovation. Industry-driven solutions, such as improved reusability, alternative materials and recycling programs, will be instrumental in ensuring that VL adoption remains both clinically and environmentally viable.

Together, innovation and sustainability form a robust foundation for the widespread adoption of VL. By fostering technological advancements while prioritising ecological and economic sustainability, the medical community can drive progress toward more equitable and responsible healthcare solutions worldwide. Institutions that foster a culture of continuous improvement in patient care are better positioned to adopt new technologies quickly and effectively.

Recommendation

R11. Experts suggest that innovation and sustainability programs are essential to achieve universal adoption of videolaryngoscopy and to ensure it remains sustainable over time.
Expert opinion (strong agreement, 95% consensus among experts)

Question: Is research necessary to facilitate the universal adoption of videolaryngoscopy?

Justification

Despite extensive evidence supporting videolaryngoscopy's advantages over direct laryngoscopy, several unanswered questions and research opportunities remain. Future studies should move beyond device comparisons to explore broader aspects of airway management, training and implementation.[53,127]

Key research priorities include establishing national airway event registries to systematically collect and analyse data, refining best practices. Additionally, understanding barriers and facilitators to adoption and clinician attitudes is essential for overcoming logistical, financial and educational challenges that hinder widespread implementation.[3] Research facilitates auditing of the universalisation process, offering data to evaluate progress, adherence to standards and the effectiveness of implemented strategies.

Further investigation is needed to assess videolaryngoscopy's impact on specific patient subgroups, such as obstetric patients and those with anticipated difficult airways. Its role in prehospital and emergency settings also warrants exploration, as does the long-term impact of its widespread adoption on clinical outcomes and healthcare systems.

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Another critical focus is skill acquisition and retention, particularly among trainees. Furthermore, standardising research outcomes will enhance comparability across studies and facilitate high-quality evidence synthesis.

There is still research to be done regarding the optimum method of endotracheal tube delivery, ensuring efficient and reliable intubation techniques across various clinical scenarios. Additionally, determining the best type of device—whether channelled, hyperangulated, or other configurations—remains an area of active investigation to optimise success rates and ease of use.

Finally, evaluating economic and environmental impacts is crucial, particularly in resource-limited settings, with an emphasis on cost-effectiveness and sustainability strategies. Addressing these research gaps will support the efficient use of VL at all levels of care, and the optimal integration of videolaryngoscopy into clinical practice.

Recommendation

R12. Experts suggest that research is necessary to evaluate the universalisation process.
Expert opinion (strong agreement, 95% consensus among experts)

Conclusion

Historically, integrating scientific evidence into medical practice has taken decades.[128] A notable example is the prolonged adoption of preoperative fasting guidelines.[129] In contrast, industries like aviation, adopt new safety enhancing technologies almost immediately. When advancements are identified, they are swiftly integrated into fleets and pilot training, establishing aviation as one of the safest industries globally. This proactive approach offers a valuable model for healthcare to emulate.[3]

As we advance toward the universal adoption of videolaryngoscopy, embracing a similarly proactive approach could bridge the gap between evidence and practice. Rapid integration of videolaryngoscopy, supported by comprehensive training, evidence-based guidelines and interdisciplinary collaboration, will not only enhance patient safety but also cultivate a culture of continuous improvement in airway management.

An essential factor in this transition is recognising the importance of blade type and user experience. Unlike direct laryngoscopy, where differences in Macintosh blade shape are minimal, videolaryngoscopy introduces significant variability in blade design, impacting usability and performance. The effectiveness of videolaryngoscopy is not only dependent on the device itself but also on the clinician's familiarity and proficiency with different blade types. Ensuring adequate training and standardisation in blade selection will be crucial to optimising videolaryngoscopy implementation.

By following the aviation industry's example of prompt adoption and standardisation, healthcare can accelerate the transition from innovation to standard care, improving outcomes and reducing delays. Achieving universal availability and acceptance of VL as a primary tool in airway management reflects a steadfast commitment to excellence, safety and the advancement of patient care.

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How the low quality of evidence could affect implementation in diverse clinical settings.

The low quality of evidence identified during the synthesis of recommendations may present significant challenges for implementation in diverse clinical settings. In particular, the lack of robust data may reduce confidence in the outcomes, especially in resource-limited environments or where clinical standards vary widely. To address these limitations, it is crucial to emphasise the consensus achieved by experts, using this endorsement as a bridge between limited evidence and clinical practice. This approach ensures that the recommendations are considered relevant and applicable even in challenging contexts.

Plans for periodic updates as higher-quality evidence emerges.

Given that technology and clinical practices are constantly evolving, a key component of the guideline's success is planning for periodic updates. These reviews will allow the incorporation of higher-quality evidence as additional studies on videolaryngoscopy are published. We propose a continuous process of literature monitoring and the organisation of consensus conferences at regular intervals to ensure that the recommendations reflect the most recent and effective practices.

Measurable outcomes or indicators to evaluate the success of these recommendations.

To assess the impact of implementing the recommendations, we suggest establishing key performance indicators, such as:

1. Increased use rates of videolaryngoscopy in tracheal intubation procedures.

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2. Reduction in complications associated with intubation (hypoxia, trauma, oesophagitis, etc.).
3. Improved first-attempt success rates in tracheal intubation.
4. Periodic assessments of healthcare professionals' satisfaction and confidence in using videolaryngoscopy.
5. Decreased costs associated with complications and shorter hospital stays due to enhanced airway management safety.

These metrics will provide clear and objective tracking of the impact of videolaryngoscopy universalisation, ensuring continuous improvement and alignment with the proposed objectives.

Terminological Considerations

DL equals Macintosh laryngoscope.

VL includes devices with a Macintosh-type blade, a hyperangulated blade, and channelled videolaryngoscopes.

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VISUAL ABSTRACT

Guidelines on Strategies for the Universalization of Videolaryngoscopy

METHODOLOGY

- Led by SEDAR, SEMES, FLAME.
- Panel of 50 experts.
- PRISMA-RR.
- GRADE & Delphi consensus.
- Six key domains.

KEY RECOMMENDATIONS

1. VL over DL as the primary TI device is recommended.
2. VL is more cost-minimizing than DL.
3. VL ensures a higher quality of care than DL.
4. VL improves human factors over DL.
5. VL should be universally available in all airway management areas.
6. Evidence-based guidelines should integrate VL as the standard.
7. The use of specific VL algorithms and cognitive aids facilitates adoption
8. A dedicated VL TI scale will support adoption.
9. High-fidelity simulation is key for VL training.
10. Awareness programs help overcome resistance to VL.
11. Innovation and sustainability ensure long-term VL adoption.
12. Research is needed to assess universalization.

SEDAR: Spanish Society of Anesthesiology, Resuscitation and Pain Therapy; SEMES: Spanish Society of Emergency Medicine; FLAME: Latin American Forum on Airway Management; VL: Videolaryngoscopy; DL: Direct Laryngoscopy; TI: Tracheal Intubation.

- VL should become the standard of care for tracheal intubation.
- A proactive approach, modeled after high-reliability industries such as aviation, can bridge the gap between evidence and widespread clinical implementation.

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